Variables, Operations, Numbers, Oh My!

Strand: Patterns, Functions, Algebra

Topic: Describing the concept of variable and using variables to explain and write expressions and equations

Primary SOL: 5.19 The student will
- a) investigate and describe the concept of variable;
- b) write an equation to represent a given mathematical relationship, using a variable;
- c) use an expression with a variable to represent a given verbal expression involving one operation; and
- d) create a problem situation based on a given equation, using a single variable and one operation.

Materials

- Paper
- Poster-size paper
- Markers

Vocabulary

expression, equation, variable, variable expression

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Pose the following situation, *"Gina has seven stickers for her sticker book. Her teacher gives her some more."* Ask, *"How would I write this mathematically?"* Have students discuss in pairs. Some possible responses might be, "7 + a number of stickers," "7 + ___" or "7 + □" . Facilitate a discussion that uses students' responses to bridge from 7 + a number of stickers to realizing that the number of stickers Gina receives is an unknown and could be any number. Let students know that mathematicians agreed to use alphabet letters for an unknown, so this situation can be written as 7 + *s*, where *s* stands for an unknown quantity called a *variable*. A *variable* is a symbol that can stand for an unknown number or for a quantity that changes. An *expression* with a variable is like a phrase; a phrase does not have a verb, so an expression does not have an equal symbol (=). Ask students whether we could write an equation for this situation. What more do we need to know for this to be an equation? (We would need to know the number of stickers the teacher gave her, which would be the sum of 7 and *s*.) Discuss the difference between equations and expressions. Make an anchor chart that includes the terms *variable*, *expression*, and *equation*.
2. Write *"n* + 3" and "3 + n" on the board, and ask students to work in pairs and create a situation that would be described with these expressions. Have two pairs join together to share. Walk around and listen in to determine which teams you want to share. Ask several teams to share. Make two columns on the board, one for n + 3 (three more than

n) and one for 3 + n (n more than three) and write situations under the best-fit expression.

3. Share with students that variables can be used with any operation. Write these situations on the board, and have teams create the expression that goes with each. Explain that the variable will represent the amount of candy. Ask partners to write an expression with variables, operation symbols, and numbers to represent each description.
    - A full bag of candy was shared with 3 people
    - 3 full bags of candy
    - A full bag of candy where 3 pieces are missing
    - A full bag of candy where 3 pieces are added

    Circulate and facilitate through questioning as needed so the teams understand $\frac{c}{3}$, 3c, c - 3, and c + 3. Facilitate a discussion to help teams develop an understanding that the variable can represent many different numbers no matter what the output is.
4. Write *n* + 3 = 8 on the board. Ask how this is different from the variable expression. (Now there is an equal sign and the number 8 is the sum of n and 3.) Explain that this variable expression with an equals sign is called an *equation*. Add this to the anchor chart. Include some development of the purpose of the variable in the open expression n + 3 and closed equation n + 3 = 8. Make sure students are not solving equations at this point but pulling on their understanding of equality and simple arithmetic. Ask them what would make n + 3 = 8 a true statement and whether they can think of two different ways. Some responses to listen for are that only one number, 5, can be added to 3 to make 8 in the equation, or I know that 8 is 5 + 3, so the *n* has to be 5. However, there are many possible replacements for the *n* in the expression n + 3, because no sum is given and you do not have to make two sides equal to each other.
5. Have students work in groups of four and provide them with a large piece of paper (poster size). Ask students to divide the paper into four equal sections and label each section Addition, Subtraction, Multiplication, and Division. Then ask each member of the team to choose an operation and sit in front of that section of the poster. Then on the board, write n + 5 = 12; 12 – n = 5; n x 5 = 15; 15 ÷ n = 5. Direct each student to write the equation corresponding to their operation in their section. Then they are to create a story problem or situation that can be represented by their equation. When groups are finished, display the posters in the room. Give students a chance to take a gallery walk to view and think about others' work. Next, have students remain standing so they can see all of the posters. Ask for questions and make comments about the similarities in the stories for each operation. Have students return to their desks and write in their notebooks what they would tell the principal if he/she asked them what they learned in mathematics today.

Assessment

- **Questions**
    - What is a variable? Why are variables used?

  - What does the equation $v \times 6 = 36$ mean? Explain using pictures, numbers, words, and symbols.
  - Explain the similarities and differences in $a - 5 = 13$ and $a - 5$.
  - What is an expression, and how is it different from an equation?
- **Journal/writing prompts**
  - Using the variable *r* and the numbers 4 and 12, write four different expressions, one for each of the four operations. Create a situation for each variable expression, and draw a picture to describe each.
  - Explain the difference between an equation and an expression. Be sure to include a situation for both.
  - Explain why it is necessary to use variables in some situations.
- **Other Assessments**
  - What are the similarities and differences between $m + 3$ and $3 + m$? Explain in pictures and words.
  - What is the difference between $k \div 4$ and $4 \div k$? Explain in pictures and words.

Extensions and Connections (for all students)

- Give students a chance to present their posters from this lesson to the class. Each member of the team discusses his or her story problem or situation. Let students in the class ask questions about anything they do not understand, and have the presenter clarify, defend, or restate in a different way.
- Students complete an input-output table for each of these expressions so that the table includes the output for six different inputs.
  a) $n + 5$
  b) $n - 5$
  c) $n \times 5$
  d) $n \div 5$
- Students will make up a card game based on the rules for Go Fish. Each set will have three cards with an expression or equation on one card, the verbal description on a second card, and a story problem or situation on the third.

Strategies for Differentiation

- Some students may need to use a box or a line for the unknown number first, then replace it with a variable.
- Provide students with a laminated problem-solving mat. Use manipulatives or dry-erase markers when creating equations.